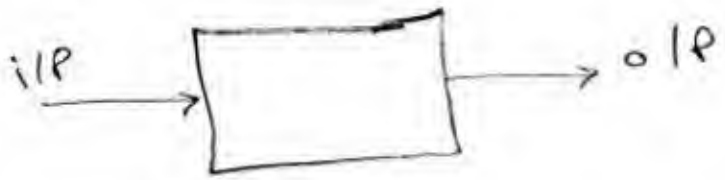
classification (classification of systems)

1 no. of I/Ps and O/Ps

a) SISO



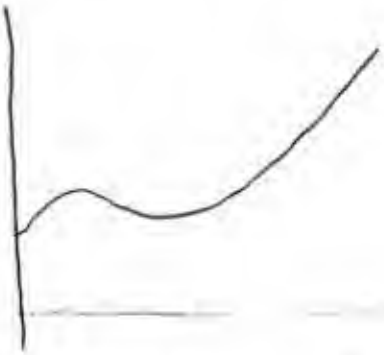
b) SIMO

c) MISO

d) MIMO

[2] Continously of signal

a) Cont.-time system



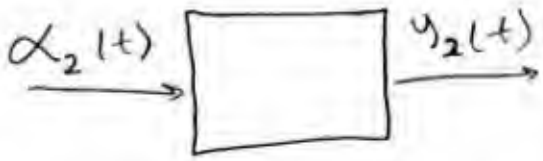
≡ Analogue system

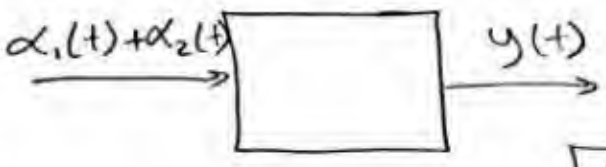
b) discrete-time sys.

≡ digital sys.

[3] Linearity property :-

a) Linear sys.





if

$y(t) = y_1(t) + y_2(t)$

→ Linear sys.

if not

→ non Linear

b) non-Linear sys

[4] Physical Comp.

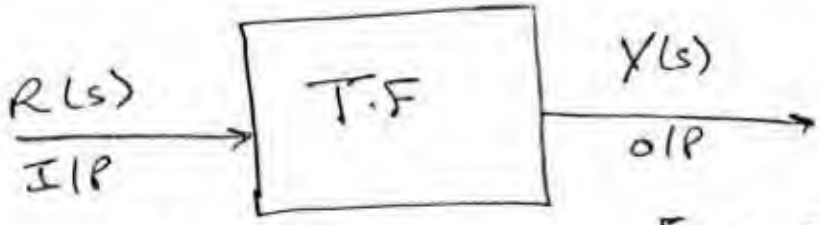
electrical | Mechanical | electro Mech | fluid

→ The system can be in the form of:-

- → Physical model
- → Block diagram or signal flow graph
- → state-space eqn.
- → system eqns.
- → Transfer function

System Response

→ o/p in time domain

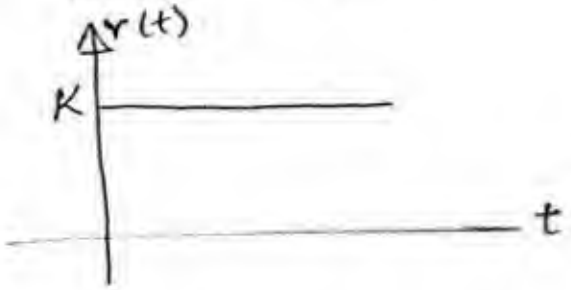


$$T.F = \frac{Y(s)}{R(s)} \Rightarrow Y(s) = [T.F]\, R(s)$$

$$\mathcal{L}^{-1}[Y(s)] = \mathcal{L}^{-1}[T.F * R(s)]$$

→ according to the i/p

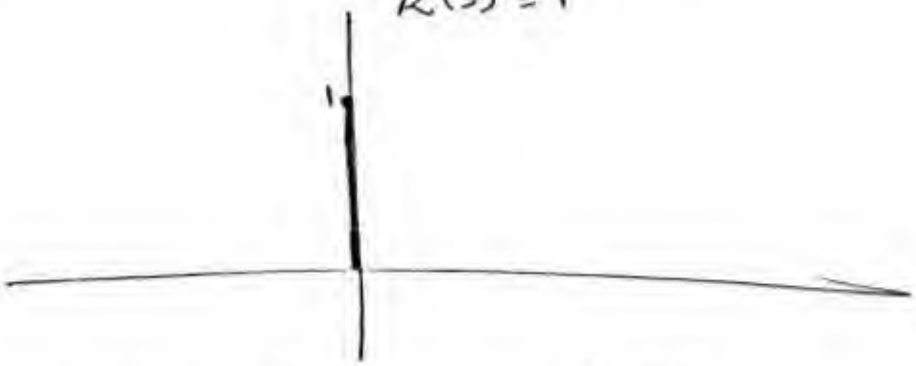
① step response $(r(t) = K)$



② Ramp Response $(r(t) = Kt)$

③ Parabolic i/p $(r(t) = Kt^2)$

④ impulse response $(r(t) = \delta(t))$

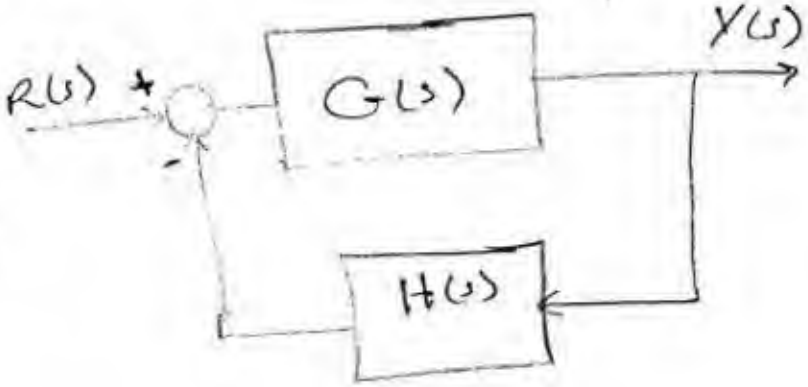


$$r(t) = \delta(t) = \begin{cases} 1 & t = 0 \\ 0 & \text{otherwise} \end{cases}$$

stability:

stable ⇒ for bounded i/p, there exist bounded o/p

Feedback system



$$T.F = \frac{G(s)}{1 + G(s) \cdot H(s)}$$

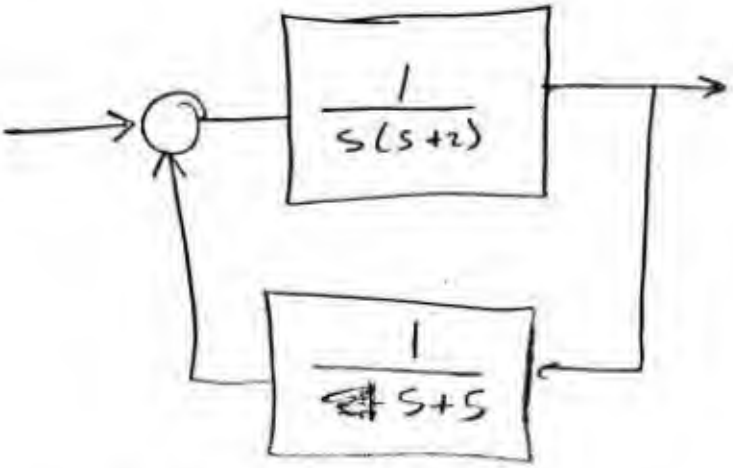
* Closed-loop T.F = C.L.T.F = T.F
* open loop T.F = O.L.T.F = $G(s) \cdot H(s)$
* ch. equation ⇒ $1 + G \cdot H(s) = 0$
* Poles ⇒ The roots of ch.eqn.
* Zeroes ⇒ The values of s that makes $G(s) = 0$

* System type ⇒ O.L.T.F

Ex

$$= \frac{1}{s^{(1)}(s+2)(s+5)}$$

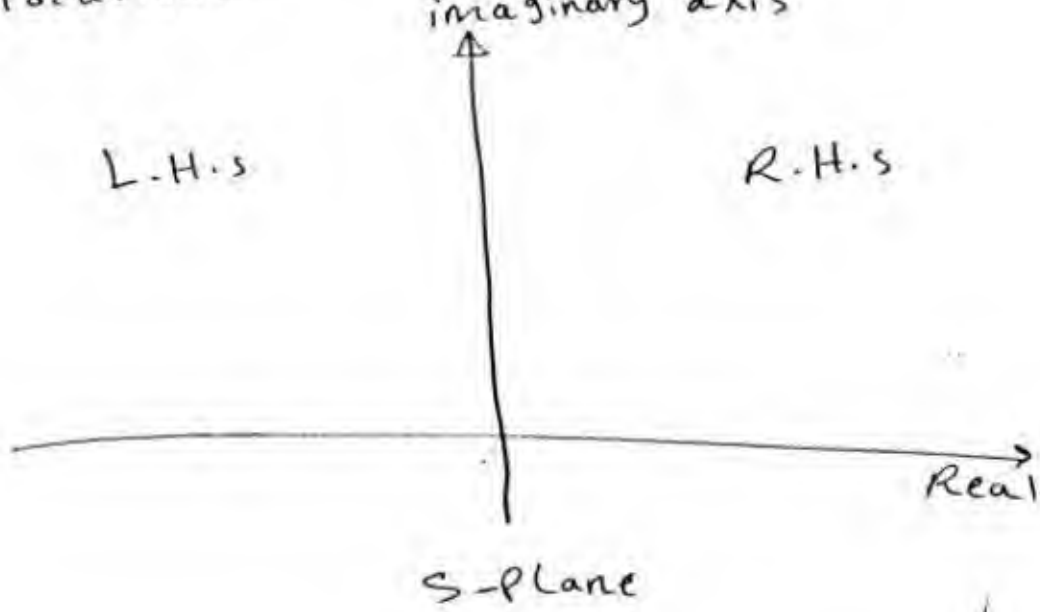
type = 1



* system order or system degree :-

$$\frac{1}{s(s+2)(s+5)} \Rightarrow \text{3rd order}$$

→ To check the system stability using the poles location :-



← لذلك لما إحتاج ختبر الـ (stability) تعامل مع (Poles) وليس الـ (Zeroes)

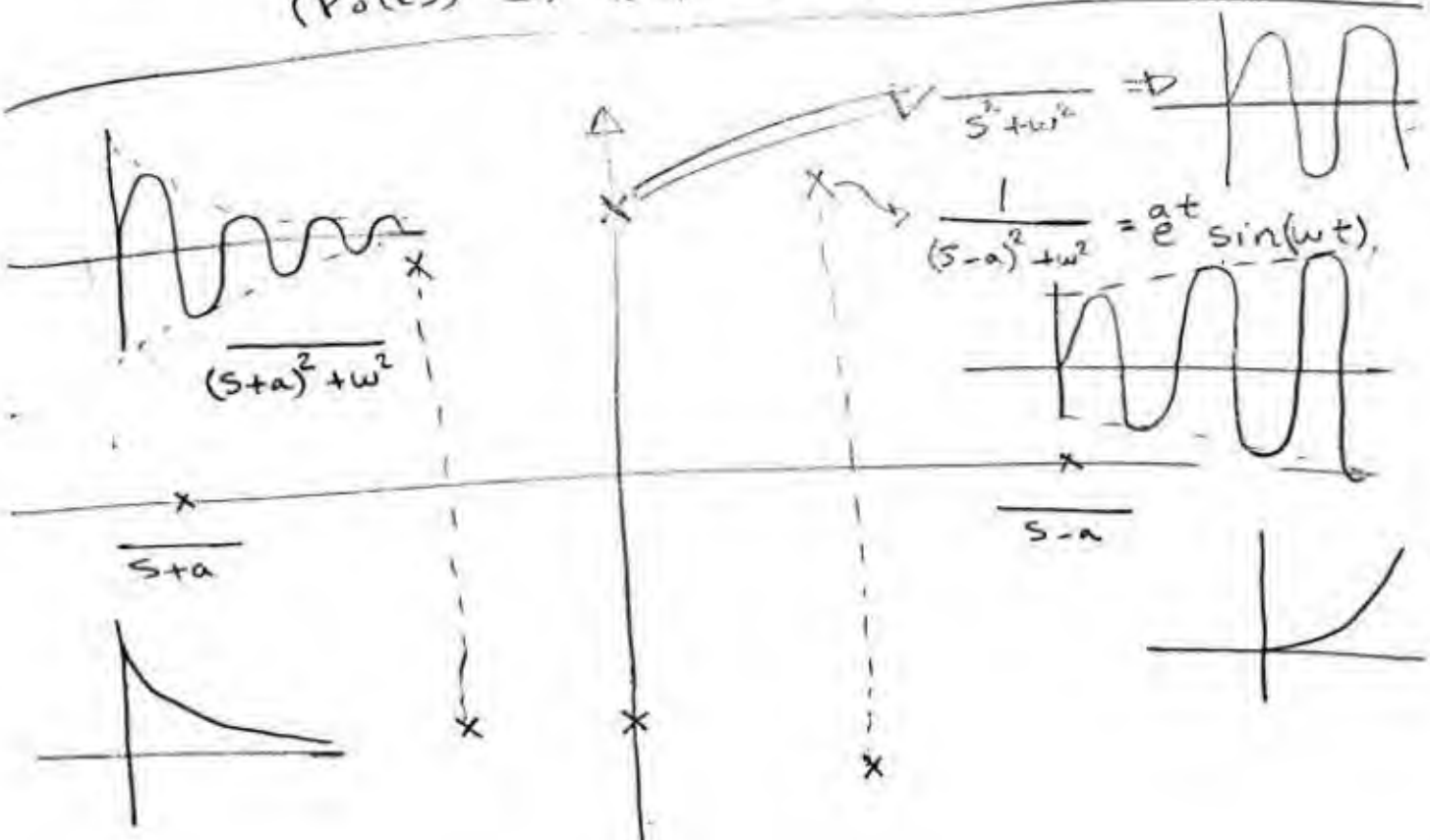
ex

$$T.F = \frac{s+2}{(s+3)(s+5)} \qquad R(s)=1$$

$$X(s) = \frac{s+2}{(s+2)(s+5)} = \frac{A_1}{s+3} + \frac{A_2}{s+5}$$

$$y(t) = A_1 e^{-3t} + A_2 e^{-5t}$$

← هنا الـ (Zeroes) أعطاك رقم بيكبر أو صغر الرسم الناتج بس لكن التأثير يكون بسبب الـ (Poles)



→ To check the system stability

- * Algebric
  - Routh method.
- graphical method
  - Root locus
  - Bode diagram
  - Polar plot.

→ another classification:-

① ~~Relative~~ Absolute stability

- Routh Array
  - → stable
  - → unstable
  - → critically stable.

② Relative stability :-

- → Bode diagram
- → Polar plot

ـ بيخليك تعرف مدى ال (stability) للنظام

more stable or .....